# Cognitive Motivations for the Initiation of Ritualistic Hand Washing in Obsessive-Compulsive Disorder

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**Abstract**

**Background**: There is little research on cognitive factors that characterize the initiation of compulsive washing in obsessive-compulsive disorder (OCD). The present study seeks to contribute to a better understanding of the goals that are salient at the start of compulsive hand washing.

**Methods**: Thirty-eight individuals diagnosed with OCD with predominantly hand-washing compulsions and two comparison groups, one with 41 individuals diagnosed with OCD without washing compulsions and one with 43 nonclinical individuals, were interviewed about a situation when they needed to wash their hands. Participants' goals for the wash and step-by-step descriptions of the wash were categorized and compared between groups.

**Results**: Findings indicate that some factors involved in the maintenance and termination of a compulsive wash might already be established at the outset of the wash, such as goals being characterized by higher levels of abstractness and importance for participants with predominantly hand-washing compulsions compared to controls. Number of goals was associated with number of repetitions of the compulsive wash.

**Conclusions**: Individuals with hand-washing compulsions might have goals in mind right from the start of the wash that are very difficult to reach. If our findings are confirmed in future studies, therapeutic implications could include exploring the adaptiveness of having abstract goals and their exaggerated importance.

*Keywords*: Obsessive-compulsive disorder; contamination; hand washing

# Cognitive Motivations for the Initiation of Ritualistic Hand Washing in Obsessive-Compulsive Disorder

In obsessive-compulsive disorder (OCD), compulsive hand washing is one of the most frequently occurring compulsions. More than half of individuals diagnosed with OCD (47.2–67.7%) experience washing or cleaning compulsions, irrespective of cultural variations (Fontenelle, Mendlowicz, Marques, & Versiani, 2004). Of all cleaning and washing rituals, hand washing is the most common (Rachman, 2004). Typical compulsive hand washing includes elaborate rituals, for example, washing between the fingers by interlocking the hands a fixed number of times, lathering the palms with a particular amount of soap, and/or rinsing the tap repeatedly. Hand-washing episodes can become so excessive that the skin becomes sore and starts bleeding, and in extreme cases, it results in skin conditions requiring treatment in their own right (Kawahara, Ueda, & Mitsuyama, 2000).

Several studies have addressed various factors involved in the *maintenance* and *termination* of compulsive hand washing in recent years (Bucarelli & Purdon, 2015; Cougle, Goetz, Fitch, & Hawkins, 2011; Hinds, Woody, Van Ameringen, Schmidt, & Szechtman, 2012; Taylor & Purdon, 2016; Wahl, Salkovskis, & Cotter, 2008). Surprisingly, however, little is known about the factors involved in the *initiation* of a compulsive hand wash. If prominent cognitive factors could be identified that are then shown to be associated with the prolongation of the wash, this would likely have therapeutic implications by extending the focus on the end of a compulsive wash to include motivating factors at its initiation. This study's aim was therefore to contribute to a better understanding of the cognitive factors involved in the start of compulsive hand washing by comparing phenomenological data of individuals with compulsive hand-washing symptoms, individuals with other obsessive-compulsive problems, and community controls.

Wahl et al. (2008) suggested that individuals with compulsive washing problems use elevated evidence requirements (EERs) to decide when to stop washing. This means that

when a decision is considered important, individuals with compulsive washing problems might consider multiple criteria, such as looking at their hands and washing for a certain amount of time. In the end, the decision is based primarily on subjective or emotional criteria, such as seeking a particular mood state, a "feeling of rightness," or the absence of doubts. In contrast, when individuals without compulsive washing problems feel that they really need to wash their hands, for example, after gardening or touching chemicals, they might base their decision on more objective, concrete criteria, such as visible dirt. Deciding if subjective or emotional criteria are met is inherently more difficult than judging concrete, more objective criteria, and therefore an obsessive washing procedure might continue for a longer time. Additionally, a series of studies demonstrated that individuals with OCD in particular may have difficulties adequately accessing internal states, which makes it even more difficult for them to decide when to stop a compulsive action (Dar, Lazarov, & Liberman, 2016; Lazarov, Liberman, Hermesh, & Dar, 2014).

The adoption of EERs for the performance of rituals means that individuals with washing compulsions use not only qualitatively different criteria but also *more* criteria than individuals without washing compulsions, so that the decision-making process and thereby the washing episode are further prolonged. Consistent with these assumptions, individuals with washing compulsions reported using more subjective criteria and overall more criteria than individuals with other obsessive-compulsive problems and healthy controls, in an interview study and during an actual wash in the laboratory (Wahl et al., 2008). Convergent findings also come from a study that investigated the "level of identification" (Vallacher & Wegner, 1985, 1087) of hand washes in patients with OCD and hand-washing rituals and matched controls (Dar & Katz, 2005). Compared to controls, patients with OCD agreed more with items reflecting the wash's purpose or higher goal, such as to feel cleansed, and less with items reflecting its technical aspects or concrete goal, such as to protect one's mouth from germs. The authors concluded that more than physical cleanliness, the goal of the wash for

individuals with hand-washing compulsions is to achieve a specific internal state, such as a feeling of confidence. Notably, the use of EERs is not limited to washing compulsions but is also relevant to terminating compulsive checking (Salkovskis, Millar, Gregory, & Wahl, 2017).

One important question that has not been addressed so far is whether indications of EERs are linked to the start of a compulsive wash. For example, for individuals with predominantly hand-washing compulsions, is the idea of reaching more subjective as opposed to more objective goals already present at the outset of a compulsive wash? Is there already an awareness of striving for *more* goals with the wash, compared to controls? Is the importance of achieving these goals higher than in controls? If indications of EERs at the start of compulsive washes should be confirmed, this might extend the theoretical conceptualizations of EERs.

Clinical observations describe compulsive hand washing as "meticulous, ritualistic, unchanging, very difficult to control and so thorough that it will be repeated again and again even though it abraids [sic] the skin" (Rachman, 2004, p. 1238). However, systematic studies addressing key characteristics of compulsive hand washes are rare. Relative to individuals with anxiety disorders, patients with obsessive-compulsive contamination fears experience more hand-washing episodes per day (Vickers et al., 2017), with extreme frequencies of 40–50 times a day (Giles, 1982). Hand washing reduces anxiety and discomfort (Hodgson & Rachman, 1972) and individuals with hand-washing compulsions reported that they also experienced an increase of positive feelings such as satisfaction and relaxation at the end of a compulsive hand wash (Sieg & Scholz, 2001).

One key feature of compulsive hand washing is its extended duration. Studies have shown that compulsive hand washing lasts longer than hand washes in nonpsychiatric controls (Hinds et al., 2012) or in individuals with compulsive checking concerns (Wahl et al., 2008). The average duration of a hand wash was 106.33 s in a laboratory study for individuals with

hand-washing compulsions, compared to 57.24 s for healthy controls (Wahl et al., 2008), and 131.69 s in a laboratory study for individuals high in contamination fears, under conditions of high responsibility, compared to 76.40 s for individuals low in contamination fears (Taylor & Purdon, 2016). The length of the wash seems to be the result of repetitions of specific steps of the wash, rather than a repetition of the entire wash or prolongation of individual actions (Taylor & Purdon, 2016). Results from a study with individuals diagnosed with various OCD problems have also indicated that—apart from repetition—compulsive behavior is characterized by the insertion of additional actions that are unnecessary for the completion of the task (Zor et al., 2009). However, neither the total number of steps of a compulsive wash nor the number of steps that are repeated nor the total number of repetitions has been investigated in individuals diagnosed with OCD and hand-washing compulsions. Behavior repetitions might have a detrimental feedback effect on cognitive variables, such as reduced sensory confidence (Taylor & Purdon, 2016). The present study assessed these frequencies and their associations with the goals of the wash.

The main objective of the study was to investigate whether indications of EERs were evident in the goals that participants reported wanting to achieve with the wash. As an additional analysis, we analyzed the step-by-step descriptions of typical compulsive hand washes with the aim of describing some key aspects of the compulsive washes, such as number of steps involved in the wash, and testing whether these were related to the goals of the wash.

We predicted that indicators of EERs would be more frequent in individuals diagnosed with OCD with compulsive hand washing ("washers") compared to two control groups: individuals diagnosed with OCD with other obsessive-compulsive problems ("nonwashers") and nonclinical controls ("NC controls"). By designating individuals with OCD but not washing compulsions as a control group, we controlled for OCD-typical characteristics such as level of anxiety or presence of obsessions. This group was not expected to use

EERs in the context of hand washing (but possibly in the context of checking or ordering, depending on their main obsessive problem). We predicted that goals would be less frequently concrete for washers than for both control groups (Hypothesis 1a), that washers would report emotional states, such as a reduction in anxiety or an increase in relaxation, more often than both control groups (Hypothesis 1b), that washers would rate the achievement of goals as more important (Hypothesis 1c), and finally, that washers would report a greater number of goals compared to both control groups (Hypothesis 1d).

Regarding the analysis of the steps of the wash, we hypothesized that washers would report a greater number of steps (i.e., observable, consecutive actions) involved in the wash (Hypothesis 2a), a greater number of steps that had to be repeated (i.e., actions that were repeated at least twice; Hypothesis 2b), and a higher number of overall repetitions (i.e., the total number of consecutive actions per wash; Hypothesis 2c) than both control groups. In an additional exploratory analysis, we examined the associations between these three variables and the variables related to the goals of the wash.

## Methods

### Participants and Procedure

Thirty-eight individuals diagnosed with current OCD who experienced predominantly hand-washing compulsions (washers), 41 individuals diagnosed with OCD who experienced no washing compulsions, (nonwashers), and 43 participants without any known mental disorders (NC controls) participated in this study. Diagnosis was based on *Diagnostic and Statistical Manual of Mental Disorders* (4th ed.; *DSM-IV*; American Psychiatric Association, 1994) criteria, using the Structured Clinical Interview (SCID: First et al., 1995) administered by experienced clinicians or a trained research worker. Washers were defined as follows: Participants met *DSM-IV* criteria based on compulsive hand washing alone or based on washing and other OCD symptoms, but compulsive hand washing was more time consuming, interfered more with the person's life, or was more distressing compared to other OCD

symptoms. Washing compulsions were defined a priori as repetitive hand washing a person feels driven to perform due to obsessional fears or rigid rules. The presence of washing compulsions was established shortly before the SCID interview (First et al., 1995) was conducted. All participants were asked what their most troublesome compulsions were. If they reported compulsive hand washing, the interviewer first decided whether the defining criteria for hand washing were met. If they were met, they explored together with the participant if compulsive hand washing was more time consuming, interfered more with the participant's life, and was more distressing than the other obsessional problems. If these and SCID criteria were met, participants were included as washers. Nonwashers were defined as meeting *DSM-IV* criteria based on any OCD symptoms other than washing. Participants with any OCD symptoms and subclinical levels of hand washing were not included. Exclusion criteria were past psychotic episodes and age below 18 or over 75 years. The screening sheet of the SCID was used to screen NC controls for mental disorders. Those who endorsed any of the screening items were excluded.

Individuals diagnosed with OCD were recruited from two outpatient services (Department of Psychiatry, University of Oxford, and Institute of Psychiatry, King's College, London) and from a self-help group ("Obsessive Action") as part of larger study. Individuals without any diagnoses (NC controls) were recruited from a database of individuals who had indicated an interest in taking part in research. All participants were paid travel expenses.

Table 1 shows demographic variables, comorbidities, medication, and clinical characteristics (depressive symptoms, anxiety, obsessive-compulsive symptoms, and state anxiety). There were no differences between groups on age, $F(2,119) = .44$, $p = .643$, gender ratio, $\chi^2(2) = 2.26$, $p = .324$, or marital status, $\chi^2(2) = 1.88$, $p = .390$. Only a small proportion of NC controls did not work, which was reflected in a significant group difference, $\chi^2(2) = 11.13$, $p = .004$.

The number of participants with at least one concurrent comorbid disorder, $\chi^2(1) = 1.41$, $p = .235$, the duration of OCD, $t(75) = 1.07$, $p = .287$, and the proportion of participants who took psychopharmacological medication, $\chi^2(1) = 2.56$, $p = .278$, were not different between washers and nonwashers. To test group differences on the clinical variables (depression, anxiety, obsessive-compulsive symptoms, and state anxiety) we conducted one-way analyses of variance (ANOVAs) with group (washers, nonwashers, and NC controls) as a between-subjects factor and Tukey's honestly significant difference (HSD) follow-up tests. Tukey's HSD has both good power and tight control over the Type I error rate when sample sizes are equal (Field, 2009). Results are shown in Table 1. Washers and nonwashers did not differ in level of depression (Beck Depression Inventory, BDI-II; Beck et al., 1996), anxiety (Beck Anxiety Inventory, BAI; Beck, Steer, & Garbin, 1988), or state anxiety (state version of the State-Trait Anxiety Inventory, STAI; Spielberger, 1983). Washers experienced more severe washing compulsions (washing subscale of the Obsessive-Compulsive Inventory, Revised, OCI-R; Foa, Kozak, Salkovskis, Coles, & Amir, 1998) and higher overall symptomatology (OCI-R, total score) compared to nonwashers and NC controls. All other OC symptom dimensions (checking, neutralizing, ordering, obsessions) did not differ between washers and nonwashers. NC controls had lower scores on all clinical variables than the two OCD groups.

All participants completed informed consent forms prior to participating in the study. The study was covered by an ethics approval from the Institute of Psychiatry, King's College London. The day before they participated in the study, they completed a questionnaire pack with the standardized questionnaires that was sent to them by mail. On arrival, they participated in a semistructured interview about the start of a compulsive or most needed wash, conducted by two trained postgraduate-level psychologists. The interview procedure was supervised by a senior clinical psychologist. Participants additionally took part in a second phase of the interview and a behavioral test as part of another study.

**Measures**

**Semistructured interview about the start of compulsive hand washing.**

Participants were asked to think of a *particular* situation within the last few days when they felt that they really needed to wash their hands. This was defined as

> a situation when you felt compelled to wash your hands. This means a situation when you felt driven to wash your hands. This can be in response to an intrusion (that is, doubts, ideas, or thoughts like "I am contaminated") or it may be in direct response to contamination. You might recognize the hand washing as senseless or excessive but feel you have to do it anyway.

For the NC controls, this situation was extended to a recent situation when they *most* felt that they needed to wash their hands if they could not think of a situation when they felt compelled to wash.

Participants were asked to take a few minutes to get a clear recollection of that particular wash and to think about where they were, what time of day it was, if they were alone, and how they were feeling at that time to facilitate recall of the wash. They were asked to indicate which of four hand-washing categories the situation could be allocated to (Category 1: "after going to the toilet or tasks related to body hygiene"; Category 2: "using chemicals"; Category 3: "gardening or household work"; Category 4: "other"). The type of situation was assessed to control for potential group differences being due to the specificity of the situation. Once participants had a clear picture of that particular wash in mind, they were asked to take the interviewer through the wash "step by step." The interviewer wrote down each step of the wash and repeated it to ensure that it was understood correctly. Participants were subsequently asked the following questions:

1. "When you were about to start the wash, what did you *aim to achieve* with the wash?"
2. "Did you have any other goals?"

The second question was repeated until participants answered “no.” Each goal provided was subsequently rated by the participants in terms of how important it seemed to them at that time on a 0 (*not at all important*) to 100 (*extremely important*) visual analogue scale.

The interview continued with additional questions that were part of a different study. To increase objectivity, questions, prompts, and the order of questions were standardized.

**Standardized questionnaires.** The BDI-II (Beck et al., 1996) was used to assess depressive symptoms, the BAI (Beck et al., 1988) and the STAI (Spielberger, 1983) to assess anxiety, and the OCI-R (Foa et al., 1998) to assess obsessive symptomatology.

## Data Analysis

**Qualitative analyses of the interview data.** The verbatim transcripts of the answers to the interview questions and the step-by-step description of the wash served as the raw data. If participants reported more than one goal, the qualitative analysis of the type of goal, its concreteness, and its importance focused exclusively on the first goal provided, since it was rated as more important than or at least equally important as the other goals. All goals were included in the analysis of the number of goals. Answers to the interview questions were reduced using a category system for each question developed for this purpose by an initially inductive approach, based on recommendations by Joffe and Yardley (2004). The first author read through the answers and allocated similar reasons given by the participants to a common category. One modification was subsequently made to these preliminary categories to account for theoretically meaningful concepts: Goals reflected in the answers to the first question were additionally rated for level of concreteness to capture any EERs. If there was any indication of a perceptible substance or smell, concreteness was rated as 1, otherwise as 0. Through this combination of an inductive and a deductive approach, five categories were identified. The five categories are described in the Results section Goals of the Wash.

To analyze the step-by-step descriptions of the wash, a step was defined as an observable, separable, and consecutive action. For example, the description “put more soap on

hands, rub soap around a few times" would be coded as two separate steps, whereas "cup hands and run under water" would be coded as one step.

An operational definition was provided for all categories,[1] and research assistants who were blind to group status rated all interviews using the final categories. To establish the interrater agreement on the categories, each interview was rated for a second time by a research assistant or doctoral student who was also blind to participants' diagnosis.

**Quantitative analysis.** Overall, two sets of quantitative analyses were conducted:

1. For goals: the frequency of answers categorized as concrete, the frequencies of answers falling into each category, the importance and number of goals.
2. For steps of the wash: the total number of steps (i.e., observable, consecutive actions); the number of steps that were repeated (i.e., actions that were performed at least twice), and the total number of repetitions (i.e., the total number of consecutive actions per wash).

Frequencies of categories and concreteness of goals and their respective associations with diagnostic group were analyzed using logistic regression. Odds ratios (ORs) were calculated as a measure of association and interpreted as effect sizes. Logistic regression is not reliable if for more than 20% of the cells the expected frequency is less than 5 (Field, 2009). We therefore collapsed the statistical analyses across two originally separate categories if this was semantically meaningful. To evaluate the individual contribution of each collapsed category, we present the frequencies and percentages for all categories in the tables. Planned contrasts were used to analyze whether the washers had higher scores than either control group on the continuous variables (importance and number of goals, number of consecutive steps, number of repeated steps, and total number of repetitions). Cohen's *d* was interpreted as

[1] Coding sheets are available on request from the first author.

the effect size. Pearson product-moment correlations were calculated to establish associations between number of steps, total number of repetitions, number of goals, and importance ratings, respectively. Alpha was set at $\alpha = .05$.

**Interrater reliability.** Cohen's $\kappa$ was calculated to establish interrater reliability of the categorical data, and intraclass correlation coefficients (two-way mixed model, absolute agreement, single rater) were used for continuous variables.

## Results

### Types of Hand-Washing Situations

The types of hand-washing situations that were reported in each group, chi-square statistics, and *p* values for significant group comparisons are shown in Table 2. Washers did not differ from the two control groups for "after using the toilet or tasks related to body hygiene" or "gardening or household work." However, washers reported more situations falling into the category "other" compared to nonwashers and NC controls. For washers, examples of "other" situations include getting out of bed, getting off a train, sexual activity, and having the thought that another person might not have washed their hands after using the toilet; for nonwashers, examples include handling money or picking up something from the street; for NC controls, examples include touching animals and being hugged by a person with a runny nose. For the category "touching chemicals," more than 20% of the cells had an expected frequency of less than 5 so the chi-square statistic could not be calculated.

### Goals of the Wash

**Concreteness and types of goals.** The five main categories that were identified as goals of the wash were (1) cleanliness, (2) prevention of contamination, (3) decrease in anxiety or other negative feelings, (4) increase in positive feelings, and (5) other goals, a "leftover" category of goals that did not occur frequently enough to justify a separate category, such as wanting to move on with things or prevention of social embarrassment. Quotes from participants' reports of each category are provided in Appendix A. Since

Category 5 included different goals for each group we did not calculate associations between this category and the diagnostic groups or interrater reliabilities. Categories 3 and 4 were collapsed into one category, "emotional changes," for statistical reasons (more than 20% of the cells had an expected frequency of less than 5). Table 3 shows the frequencies and percentages of concreteness and each goal category separately by group; OR statistics for the groupwise associations regarding washers and nonwashers or washers and NC controls, respectively; and interrater reliabilities. The odds of reporting a goal that was characterized by high concreteness was almost fourfold (3.85) lower for washers compared to nonwashers and almost sixfold (5.88) lower for washers compared to NC controls (Hypothesis 1a). The odds of reporting an emotional change as a goal was almost sixfold (5.86) higher for washers compared to nonwashers; the odds of reporting an emotional change were not higher for washers than for NC controls (Hypothesis 1b). Analysis of the remaining categories for which we had not specified any hypotheses produced the following results: The odds of reporting cleanliness as a goal were fourfold lower for washers compared to nonwashers, and 2.5-fold lower compared to NC controls. The odds of reporting prevention of contamination as a goal were fourfold higher for washers compared to nonwashers. For this variable, the OR for the comparison of washers with NC controls was not significant. Cohen's $\kappa$ was good for categories 1–4 and excellent for concreteness of goals.

**Importance and number of goals.** Table 4 shows the means and standard deviations of importance and number of goals per group, *t* statistics, and effect sizes. Washers rated the importance of the goals as very high on average. Planned contrasts revealed that washers rated importance of the goals higher than the two control groups, with a large effect size (Hypothesis 1c), and also reported more goals than both control groups, with a medium effect size (Hypothesis 1d).

**Steps of the Wash**

Table 5 shows the mean number of steps of the wash, the number of steps that were repeated, the total number of repetitions, *t* statistics and *p* values, effect sizes, and interrater reliabilities. Planned contrasts revealed that washers reported more steps than both control groups with a large effect size (Hypothesis 2a). Washers also reported repeating more steps than both control groups (Hypothesis 2b), and they reported an overall higher number of repetitions compared to both control groups (Hypothesis 2c) with medium effect sizes. The interrater reliability was low for number of repeated steps and acceptable for number of steps and total repetitions.

**Additional Exploratory Analyses**

For each group we conducted Pearson product-moment correlations between number of steps and total number of repetitions, with number of goals and importance ratings, respectively. Since the interrater reliability was low for number of repeated steps, we did not conduct any further analyses with this variable. A significant association was found between number of goals and total number of repetitions in washers, with a medium effect size ($r$ = .35, $p < .05$). This means that the more goals the washers reported, the more repetitions they reported conducting during the wash. The remaining correlations did not reach significance (all $p$s > .05). Complete results are presented in Appendix Table B1.

## Discussion

Consistent with Hypothesis 1a, fewer washers than controls reported goals that were characterized by high concreteness, such as removing visible dirt or an oily substance. The odds of reporting an emotional change such as a decrease in distress or an increase in relaxation as a goal were almost sixfold higher for washers compared to nonwashers. There was also a tendency for more washers to report emotional changes than NC controls, but the difference did not reach significance. The following quotes illustrate the emotional goals of washers: “I want to feel as comfortable as I was before,” “I need to get rid of the anxious feeling,” “I wanted to wash away the feelings.” In line with Hypothesis 1c and d, washers

considered their goals more important than control participants considered theirs and also reported having overall more goals than controls. While most participants aimed to achieve both cleanliness and prevention of contamination with their wash, washers reported the goal of cleanliness less frequently and the prevention of contamination more frequently than controls.

Taken together, the findings are largely consistent with the notion that EERs are already in place at the beginning of a compulsive wash in those with contamination/washing OCD, but not in other types of OCD and healthy controls. The reported goals of the wash are rarely concrete, and at the same time the achievement of these (multiple) goals is perceived as extremely important. These findings extend previous research on the operation of EERs at the end of a compulsive wash (Wahl et al., 2008). They suggest that the use of EERs typically does not occur spontaneously at the end of a wash or gradually develop during the wash, but rather that EERs are already in place at the outset of the wash. The differences in the importance of the goals between washers and controls was particularly pronounced. This may mean that individuals with hand-washing compulsions start the wash with a very clear focus and very-difficult-to-reach goals in mind, such as “to wash away the feelings.” The results also indicate that those with contamination OCD regard being sure of the outcome of a wash as important, presumably because of fears of harmful consequences and their responsibility to ensure that these are prevented (Salkovskis, 1985). Results are also consistent with the study by Dar and Katz (2005), who found that individuals with hand-washing compulsions endorsed lower levels of identification with a wash (such as cleanliness) less often and higher levels of identification (such as feeling cleansed) more often than controls. It will be interesting in future studies to explore the goals in more detail: In particular, are the goals associated with vivid and powerful images? Does the presence of goals change over the course of the wash? In what way are the goals associated with the fear that motivates the wash?

Concerning the steps of the wash, the number of reported steps (or consecutive actions) during the wash, the number of reported steps that were repeated, and the total number of repetitions reported were higher for individuals with hand-washing compulsions than for both control groups. To illustrate, a washer described the step-by-step wash as follows: "I run the tap, wet my fingers (do not wear a watch); get soap and lather hands; make sure I cover all of my hands and wrists, half-way up to the elbow; I start with the first arm, and take turns: top, bottom, top, bottom, 10 times; I am covering everything; then the second arm and hand, top of hand, bottom of hand and arm, 10 times; then I rinse off when I feel satisfied and start a counting ritual; I wash the tap." Effect sizes were large for number of steps and of medium size for number of repeated steps and total repetitions. These results are entirely consistent with Hypothesis 2a–c. However, the interrater reliability for the repeated steps was quite low, so results regarding this variable should be interpreted with caution. With an average of 14 consecutive actions per wash, washers reported performing twice as many steps as controls and repeating about 20% of the individual actions, resulting in a total average number of 23 consecutive actions per hand wash. These results are in line with findings showing that the length of a wash was accounted for by the repetition of separable actions, rather than their prolongation or a repetition of the complete wash (Taylor & Purdon, 2016). Although we did not differentiate between relevant and irrelevant actions in our study, the greater number of overall steps in washers is consistent with the idea that washers added actions that were not necessary for a hand wash, such as counting or cleaning the tap (Zor et al., 2009). The percentage of repeated actions reported was considerably smaller than in a previous study (20% in this study, 50% in Zor et al., 2009). This discrepancy may be accounted for by different definitions or reliabilities of the variable "repeated number of steps."

A positive association of medium size between the reported number of repetitions and reported number of goals is consistent with the idea that the more goals the washers had in

mind at the outset of the wash, the higher the number of repetitions. It can be interpreted as a first indication that the number of goals was related to the length of the compulsive wash.

The study had several limitations. Data consisted of verbal recollections of a recent wash, and while measures were taken to induce clear and unbiased recall (such as encouraging participants to choose a particular wash, anchor it in time and place, and form a clear picture of the wash before reporting it), we cannot exclude the possibility that memory biases or inferences might have influenced the data. Moreover, as a greater proportion of washers than controls reported hand-washing situations that did not fall into any of the predefined categories, we cannot exclude the possibility that the differences between washers and controls were partially due to the specific situations of the washers (e.g., getting off a train). Individuals spontaneously described and recalled behavior in terms of a middle level of behavioral units (Zacks & Tversky, 2001). When we asked them to take us through the wash step by step, participants might have broken down large but functional units of actions to gesture level, that is, short series of actions that made up the functional units. To the extent that this was the case, the reported number of steps of the wash might have been inflated in all groups. The relatively small number of predefined categories for typical washing situations might have compromised the comparison of these situations across groups.

Washers had higher overall symptoms and the level of education was higher for washers compared to controls, and both findings could be a potential confound.[2] We cannot exclude the possibility that higher overall symptoms might have influenced the results. For example, higher overall symptoms might be associated with higher distress before the start of the hand washing, explaining the reporting of more emotional changes as goals in the washers

[2] Due to a technical problem and unfortunate loss of data, symptom severity and years of education could not be added as a covariate in the logistic regressions.

compared to nonwashers. It seems unlikely that differences in the level of education could explain the differences between washers and controls. There is clearly a need for future studies to use methods such as video recordings or possibly wearables such as smartwatches that automatically track the beginning and end of a compulsive wash and the number of repetitions in standardized hand-washing situations, in individuals with comparable levels of overall symptom severity, in order to investigate whether our findings can be replicated. Future studies might also explicitly address additional aspects of compulsive washing such as disgust (Deacon & Olatunji, 2007), responsibility (Taylor & Purdon, 2016), or imagery (Lipton, Brewin, Linke, & Halperin, 2010).

## Conclusions

To conclude, our study provides a first look at the cognitive factors that are involved at the beginning of compulsive hand washing. Our results suggest that not only self-perpetuating mechanisms such as reductions in sensory confidence (Taylor & Purdon, 2016) or factors present at the end of the wash (Cougle et al., 2011; Hinds et al., 2012; Wahl et al., 2008), but also factors present at the beginning of a wash might be involved in determining its length and number of repetitions. Elements of EERs such as abstractness of goals, number of goals, and the high importance of the goals were reported as being present at the *outset* of a compulsive wash. Given the retrospective nature of the data and the possibility of recall biases, findings should be considered preliminary. If supported in future studies using real-time data, they could have clinical implications. Therapist might ask about abstract goals and their exaggerated importance during cognitive behavior therapy, and researchers might evaluate their short- and long-term utility in behavioral experiments. For example, individuals with washing compulsions could be asked to keep applying their abstract goals and accept the exaggerated importance of reaching them for 1 week and then in the following week to formulate more concrete goals and to accept lower levels of achievement. Patients and therapists could evaluate together whether the course of the urge to wash differs between

these weeks. Finally, our data support previous findings that compulsive washes are characterized by an extremely high reported number of repetitions of particular actions, which supports the relevance of further investigating the consequences of behavioral repetitions in compulsive washing.

**References**

American Psychiatric Association. (1994). *Diagnostic and statistical manual of mental disorders* (4th ed.). Washington, DC: Author.

Beck, A. T., Steer, R. A., & Brown, G. K. (1996). *Manual for the Beck Depression Inventory-II*. San Antonio, TX: Psychological Cooperation.

Beck, A. T., Steer, R. A., & Garbin, M. G. (1988). Psychometric properties of the Beck Depression Inventory: Twenty-five years of evaluation. *Clinical Psychology Review, 8*(1), 77–100.

Bucarelli, B., & Purdon, C. (2015). A diary study of the phenomenology and persistence of compulsions. *Journal of Behaviour Therapy and Experimental Psychiatry, 49*, 209-215.

Cougle, J. R., Goetz, A. R., Fitch, K. E., & Hawkins, K. A. (2011). Termination of washing compulsions: A problem of internal reference criteria or 'not just right' experience? *Journal of Anxiety Disorders, 25*(6), 801–805. doi:10.1016/j.janxdis.2011.03.019

Dar, R., & Katz, H. (2005). Action identification in obsessive-compulsive washers. *Cognitive Therapy and Research, 29*(3), 333–341. doi:10.1007/s10608-005-4266-5

Dar, R., Lazarov, A., & Liberman, N. (2016). How can I know what I'm feeling? Obsessive-compulsive tendencies and induced doubt are related to reduced access to emotional states. *Journal of Behavior Therapy and Experimental Psychiatry, 52*, 128–137. doi:10.1016/j.jbtep.2016.04.004

Deacon, B., & Olatunji, B. O. (2007). Specificity of disgust sensitivity in the prediction of behavioral avoidance in contamination fear. *Behaviour Research and Therapy, 45*(9), 2110–2120. doi:10.1016/j.brat.2007.03.008

Field, A. (2009). *Discovering statistics using SPSS* (Vol. 3). London, England: SAGE.

First, M. B., Spitzer, R. L., Gibbon, M., Williams, J. B. W., Davies, M., Borus, J., ... Rounsaville, B. (1995). The structured clinical interview for DSM-III-R personality

disorders (SCID-II): II. Multi-site test-retest reliability study. *Journal of Personality Disorders, 9*(2), 92–104.

Foa, E. B., Kozak, M. J., Salkovskis, P. M., Coles, M. E., & Amir, N. (1998). The validation of a new obsessive-compulsive disorder scale: The Obsessive-Compulsive Inventory. *Psychological Assessment, 10*(3), 206–214.

Fontenelle, L. F., Mendlowicz, M. V., Marques, C., & Versiani, M. (2004). Trans-cultural aspects of obsessive-compulsive disorder: A description of a Brazilian sample and a systematic review of international clinical studies. *Journal of Psychiatric Research, 38*(4), 403–411. doi:10.1016/j.jpsychires.2003.12.004

Giles, T. R. (1982). Cognitive restructuring and exposure with a compulsive washer—A test of reciprocal inhibition. *Journal of Behavior Therapy and Experimental Psychiatry, 13*(3), 221–224. doi:10.1016/0005-7916(82)90009-X

Hinds, A. L., Woody, E. Z., Van Ameringen, M., Schmidt, L. A., & Szechtman, H. (2012). When too much is not enough: Obsessive-compulsive disorder as a pathology of stopping, rather than starting. *PLoS ONE, 7*, 1–9. doi:10.1371/journal.pone.0030586

Hodgson, R. J., & Rachman, S. (1972). The effects of contamination and washing in obsessional patients. *Behaviour Research and Therapy, 10*(2), 111–117.

Joffe, H., & Yardley, L. (2004). Content and thematic analysis. In D. F. Marks & L. Yardley (Eds.), *Research methods for clinical and health psychology* (pp. 56–68). London, England: SAGE.

Kawahara, T., Ueda, Y., & Mitsuyama, Y. (2000). A case report of refractory obsessive-compulsive disorder improved by risperidone augmentation of clomipramine treatment. *Psychiatry and Clinical Neurosciences, 54*(5), 599–601. doi:10.1046/j.1440-1819.2000.00760.x

Lazarov, A., Liberman, N., Hermesh, H., & Dar, R. (2014). Seeking proxies for internal states in obsessive-compulsive disorder. *Journal of Abnormal Psychology, 123*(4), 695–704. doi:10.1037/abn0000004

Lipton, M. G., Brewin, C. R., Linke, S., & Halperin, J. (2010). Distinguishing features of intrusive images in obsessive-compulsive disorder. *Journal of Anxiety Disorders, 24*(8), 816–822. doi:10.1016/j.janxdis.2010.06.003

Rachman, S. (2004). Fear of contamination. *Behaviour Research and Therapy, 42*(11), 1227–1255. doi:10.1016/j.brat.2003.10.009

Salkovskis, P. M. (1985). Obsessional-compulsive problems: A cognitive-behavioural analysis. *Behaviour Research and Therapy, 23*(5), 571–583. doi:10.1016/0005-7967(85)90105-6

Salkovskis, P. M., Millar, J., Gregory, J. D., & Wahl, K. (2017). The termination of checking and the role of just right feelings: A study of obsessional checkers compared with anxious and non-clinical controls. *Behavioural and Cognitive Psychotherapy, 45*(2), 139–155. doi:10.1017/S135246581600031x

Sieg, J., & Scholz, O. B. (2001). Subjektives Gefühls- und Körpererleben bei Wasch- und Kontrollzwangshandlungen. *Verhaltenstherapie, 11*, 288–296.

Spielberger, C. D. (1983). *Manual for the State-Trait Anxiety Inventory STAI (form Y)*. Palo Alto, CA: Consulting Psychologists Press.

Taylor, J., & Purdon, C. (2016). Responsibility and hand washing behaviour. *Journal of Behavior Therapy and Experimental Psychiatry, 51*, 43–50. doi:10.1016/j.jbtep.2015.12.005

Vallacher, R. R., & Wegner, D. M. (1985). *A theory of action identification.* Hillsdale, NJ: Erlbaum.

Vallacher, R. R., & Wegner, D. M. (1987). What do people think they're doing? Action identification and human behavior. *Psychological Review*, *94*, 3–15.

Vickers, K., Ein, N., Koerner, N., Kusec, A., McCabe, R. E., Rowa, K., & Antony, M. M. (2017). Self-reported hygiene-related behaviors among individuals with contamination-related obsessive-compulsive disorder, individuals with anxiety disorders, and nonpsychiatric controls. *Journal of Obsessive-Compulsive and Related Disorders, 14*, 71–83. doi:10.1016/j.jocrd.2017.06.001

Wahl, K., Salkovskis, P. M., & Cotter, I. (2008). 'I wash until it feels right'—The phenomenology of stopping criteria in obsessive-compulsive washing. *Journal of Anxiety Disorders, 22*(2), 143–161. doi:10.1016/j.janxdis.2007.02.009

Zacks, J. M., & Tversky, B. (2001). Event structure in perception and conception. *Psychological Bulletin, 127*(1), 3–21. doi:10.1037//0033-2909.127.1.3

Zor, R., Keren, H., Hermesh, H., Szechtman, H., Mort, J., & Eilam, D. (2009). Obsessive-compulsive disorder: A disorder of pessimal (non-functional) motor behavior. *Acta Psychiatrica Scandinavica, 120*(4), 288–298. doi:10.1111/j.1600-0447.2009.01370.x

Table 1

*Demographics, Clinical Characteristics, Medications, and Comorbidities*

| Variable | Group | | |
|---|---|---|---|
| | Washers (*n* = 38) | Nonwashers (*n* = 41) | NC controls (*n* = 43) |
| Gender female, *n* (%) | 14 (36.8) | 19 (46.3) | 23 (53.5) |
| Age in years, *M* (*SD*) | 36.6 (11.8) | 35.8 (11.2) | 38.3 (14.6) |
| Years of education, *M* (*SD*) | 13.1 (2.6) | 14.5 (2.9) | 14.6 (2.3) |
| Employment status, *n* (%)[a] | | | |
| Employed or full-time student | 23 (62.2) | 25 (62.5) | 39 (90.7) |
| Not employed[b] | 20 (37.8) | 15 (37.5) | 4 (9.3) |
| Marital status, *n* (%) | | | |
| With partner (married or with partner) | 20 (52.6) | 17 (41.5) | 24 (55.8) |
| Without partner (single, divorced, widowed) | 18 (47.4) | 24 (58.5) | 19 (44.2) |
| Duration of OCD in years, *M* (*SD*)[c] | 16.4 (12.4) | 13.5 (10.9) | – |
| At least one comorbid diagnosis, *n* (%) | 18 (47.4) | 15 (36.58) | – |
| Medication, *n* (%)[d] | | | |

| Variable | Group | | |
|---|---|---|---|
| | Washers ($n$ = 38) | Nonwashers ($n$ = 41) | NC controls ($n$ = 43) |
| Antidepressant drugs | 18 (47.4) | 24 (58.5) | 1 (2.3) |
| Other psychopharmacological drugs (including anxiolytics and benzodiazepines) | 0 (0) | 1 (2.4) | 0 (0) |
| Depressive symptoms (BDI-II), *M* (*SD*) | 18.92 (8.86)[e] | 17.83 (9.22)[e] | 6.47 (5.67)[f] |
| Anxiety symptoms (BAI), *M* (*SD*) | 18.29 (9.94)[e] | 18.71 (9.07)[e] | 6.67 (5.08)[f] |
| State anxiety (STAI, state), *M* (*SD*) | 48.16 (11.72)[e] | 47.63 (12.02)[e] | 31.19 (9.75)[f] |
| Obsessive-compulsive symptoms, *M* (*SD*) | | | |
| OCI-R total score | 79.26 (26.74)[e] | 59.00 (26.44)[f] | 9.67 (10.13)[g] |
| OCI-R washing | 21.32 (7.93)[e] | 4.10 (4.38)[f] | 1.31 (2.02)[g] |
| OCI-R checking | 17.08 (8.33)[e] | 16.12 (8.86)[e] | 1.40 (2.21)[f] |
| OCI-R neutralizing | 7.74 (6.03)[e] | 7.68 (5.76)[e] | 1.02 (1.51)[f] |
| OCI-R ordering | 8.53 (5.01)[e] | 6.85 (6.59)[e] | 1.69 (2.29)[f] |
| OCI-R obsessions | 14.05 (8.10)[e] | 15.27 (6.87)[e] | 2.62 (4.05)[f] |

*Note.* Washers = Participants with obsessive-compulsive disorder (OCD) and hand-washing compulsions; nonwashers = participants with OCD without hand-washing compulsions; NC = nonclinical. BAI: Beck Anxiety Inventory; BDI-II: Beck Depression Inventory; STAI, state: The State-Trait Anxiety Inventory, state version; OCI-R: Obsessive-Compulsive Inventory, Revised.

[a] For one washer and one nonwasher, information about the employment status was missing.

[b] Not employed included unemployed, homemaker, or retired.

[c] For two washers the duration of the obsessional problem was missing.

[d] For one washer and two nonwashers, information about medication was missing.

[e, f] Means with different superscripts (e and f) differ significantly according to Tukey's honestly significant difference post hoc tests, $p < 0.05$.

Table 2

*Types of Hand-Washing Situations*

| Situation | Group | | | $\chi^2$ | *p* | Comparison |
|---|---|---|---|---|---|---|
| | Washers | Nonwashers | NC controls | | | |
| | *n* (%) | *n* (%) | *n* (%) | | | |
| After using the toilet or tasks related to body | 9 (26.4) | 10 (24.4) | 7 (16.3) | 0.05 | .819 | Washers vs. nonwashers |
| hygiene | | | | 0.25 | .617 | Washers vs. NCs |
| Touching chemicals | 0 (0) | 4 (9.8) | 10 (23.3) | | | [a] |
| Gardening or household work | 10 (26.3) | 19 (46.3) | 20 (46.5) | 2.79 | .095 | Washers vs. nonwashers |
| | | | | 3.33 | .068 | Washers vs. NCs |
| Other | 19 (50.0) | 6 (14.6) | 6 (13.9) | 6.76 | .009 | Washers vs. nonwashers |
| | | | | 6.76 | .009 | Washers vs. NCs |

*Note*. Washers = Participants with obsessive-compulsive disorder (OCD) and hand-washing compulsions; nonwashers = participants with OCD without hand-washing compulsions; NC = nonclinical.

[a] More than 20% of the cells had an expected frequency of less than 5 so the chi-square statistic could not be calculated.

Table 3

*Associations Between Concreteness of Goals and Goal-Type Categories, Respectively, and Diagnostic Group*

| Variable | Washers | Nonwashers | NC controls | Washers vs. nonwashers | | Washers vs. NC controls | | Cohen's κ |
|---|---|---|---|---|---|---|---|---|
| | *n* (%) | *n* (%) | *n* (%) | OR (95% CI) | *p* | OR (95% CI) | *p* | |
| Concreteness | 4 (11.1) | 14 (32.6) | 19 (42.2) | 0.26 [0.08, 0.88] | .03 | 0.17 [0.05, 0.57] | .004 | .96 |
| Category | | | | | | | | |
| 1. Cleanliness | 15 (41.7) | 32 (78.0) | 29 (65.9) | 0.25 [0.10, 0.64] | .004 | 0.39 [0.16, 0.97] | .043 | .67 |
| 2. Prevention of contamination | 11 (30.6) | 3 (7.3) | 10 (22.7) | 4.18 [1.20, 14.60] | .043 | 1.5 [0.57, 4.18] | .397 | .78 |
| 3. Decrease negative emotions | 2 (5.4) | 1 (2.3) | 1 (2.2) | | | | | .76 |
| 4. Increase positive emotions | 6 (16.7) | 1 (2.3) | 2 (4.4) | | | | | .73 |
| 3 and 4. Emotional change | 8 (21.6) | 2 (4.7) | 3 (6.5) | 5.86 [1.16, 29.66] | .033 | 4.0 [0.98, 16.39] | .054 | |
| 5. Other goals | 2 (5.4) | 2 (4.7) | 2 (4.3) | | | | | |

*Note.* Washers = Participants with obsessive-compulsive disorder (OCD) and hand-washing compulsions; nonwashers = participants with OCD without hand-washing compulsions; NC = nonclinical. CI = confidence interval; OR = odds ratio.

Table 4

*Means and Standard Deviations of Importance and Number of Goals by Group,* t *Statistics for Planned Contrasts, and Effect Sizes*

| Variable | Group | | | *t*(120) | *p* | Cohen's *d* |
|---|---|---|---|---|---|---|
| | Washers | Nonwashers | NC controls | | | |
| | *M* (*SD*) | *M* (*SD*) | *M* (*SD*) | | | |
| Importance of goal | 90.56 (12.58) | 75.24 (20.36) | 73.78 (25.05) | 3.96 | <.001 | 0.80 |
| Number of goals | 1.64 (0.76) | 1.35 (0.61) | 1.33 (0.48) | 2.44 | .038 | 0.43 |

*Note.* Washers = Participants with obsessive-compulsive disorder (OCD) and hand-washing compulsions; nonwashers = participants with OCD without hand-washing compulsions; NC = nonclinical.

Table 5

*Number of Steps, Number of Steps That Were Repeated, and Total Number of Repetitions, by Group, and Statistics, Effect Sizes, and Intraclass Correlation Coefficients*

| Variable | Group | | | *t* | *p* | Cohen's *d* | ICC |
|---|---|---|---|---|---|---|---|
| | Washers | Nonwashers | NC controls | | | | |
| | *M* (*SD*) | *M* (*SD*) | *M* (*SD*) | | | | |
| Number of steps | 14.27 (13.42) | 7.47 (4.51) | 7.30 (2.60) | 4.47 | <.001 | 0.90 | .66 |
| Number of repeated steps | 2.81 (5.87) | 0.79 (4.01) | 0.28 (1.92) | 2.80 | .006 | 0.55 | .37 |
| Total repetitions | 23.03 (68.45) | 1.76 (5.88) | 0.08 (.35) | 2.83 | .006 | 0.62 | .61 |

*Note*. ICC = Intraclass correlation coefficient, two-way mixed model, absolute agreement, single rater. Washers = Participants with obsessive-compulsive disorder (OCD) and hand-washing compulsions; nonwashers = participants with OCD without hand-washing compulsions; NC = nonclinical.

## Appendix A

Examples of goals are provided to illustrate each category. All examples are quotes taken from washers.

1. Cleanliness: “I wanted to get back to the baseline of cleanliness.”
2. Prevention of contamination: “To get rid of any germs that I might have picked up from closing the door or flushing.”
3. Decrease in anxiety or other negative feelings: “To get rid of anxious feeling.”
4. Increase in positive feelings: “I want to feel as comfortable as I was before.”
5. Other goals: “To keep thought at bay.”

## Appendix B

Table B1

*Pearson Product-Moment Correlations Between Number of Steps and Number of Repetitions With Number of Goals and Importance Ratings, Separately by Group*

| Group | Variable | Number of steps of the wash | | | Number of repetitions | | |
|---|---|---|---|---|---|---|---|
| | | *n* | *r* | *p* | *n* | *r* | *p* |
| Washers | Number of goals | 36 | .01 | .94 | 35 | .35* | .04 |
| | Importance | 36 | -.06 | .71 | 35 | -.15 | .38 |
| Nonwashers | Number of goals | 43 | -.03 | .87 | 43 | -.09 | .58 |
| | Importance | 42 | -.05 | .75 | 42 | .21 | .18 |
| Nonclinical controls | Number of goals | 45 | -.14 | .35 | 45 | -.11 | .49 |
| | Importance | 45 | .13 | .40 | 45 | .07 | .66 |

*Note.*

* $p < .05$.